Space Weather Technical Forecast

Issued on Friday, 06 October 2023 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-flares throughout. Slight chance of an isolated G1/Minor Storm interval on 06 Oct.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar Activity is Low, with only minor C-class flares observed in the last 24 hours. There are 11 sunspot regions on the visible disc, with AR3452 in the north-centre disc the largest, with AR3451 also developing and presenting an increased flare risk. AR3450 has weakened and in contrast, presents a reduced risk. The remaining regions have all not shown significant development and appear small or stable. Three CMEs have been observed in the last 24 hours, two from the northwest and one from the northeast. These will be analysed to determine if they have Earth-directed components.

Solar Wind / Geomagnetic Activity: Solar winds as observed at L1 started at mainly slightly elevated levels around 450kms, but increased to around 490km/s at 05/2131 UTC due to the arrival of a weak CME which left the Sun on 02 Oct. Density also increased from average, to above average values, reaching a peak of 13 ppcc at 05/2251 UTC. Total magnetic field strength was mostly weak throughout, but with a peak of 8 nT at 05/2206 UTC. Bz varied weakly between -7 nT and +4 nT. Phi angle has been indeterminate, but with a positive (away from the Sun) bias. Geomagnetic activity started Active, with a G1/Minor Storm interval 05/0300-0600 UTC, but has been Quiet since.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was mostly at background to moderate levels. Associated 24-hour fluence was below the Active (1e8 integrated pfu) threshold with a mostly level trend. The observation at 06/0000 UTC was 8.25e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Mainly Low with a slight chance of Moderate flare activity, mainly from AR3451 and AR3452 in north centre disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 02 Oct appears to have recently arrived at Earth, with effects from this feature expected to decline through the forecast period. Solar winds have reached close to 500km/s due to the CME with these declining towards background levels by the end of the period, in the absence of further CMEs. No coronal hole high speed streams are forecast to connect with the Earth. Quiet to Unsettled conditions at first, but with an increased risk of Active or G1/Minor Storms due to the CME. A decline back to Quiet conditions is then expected through the period.

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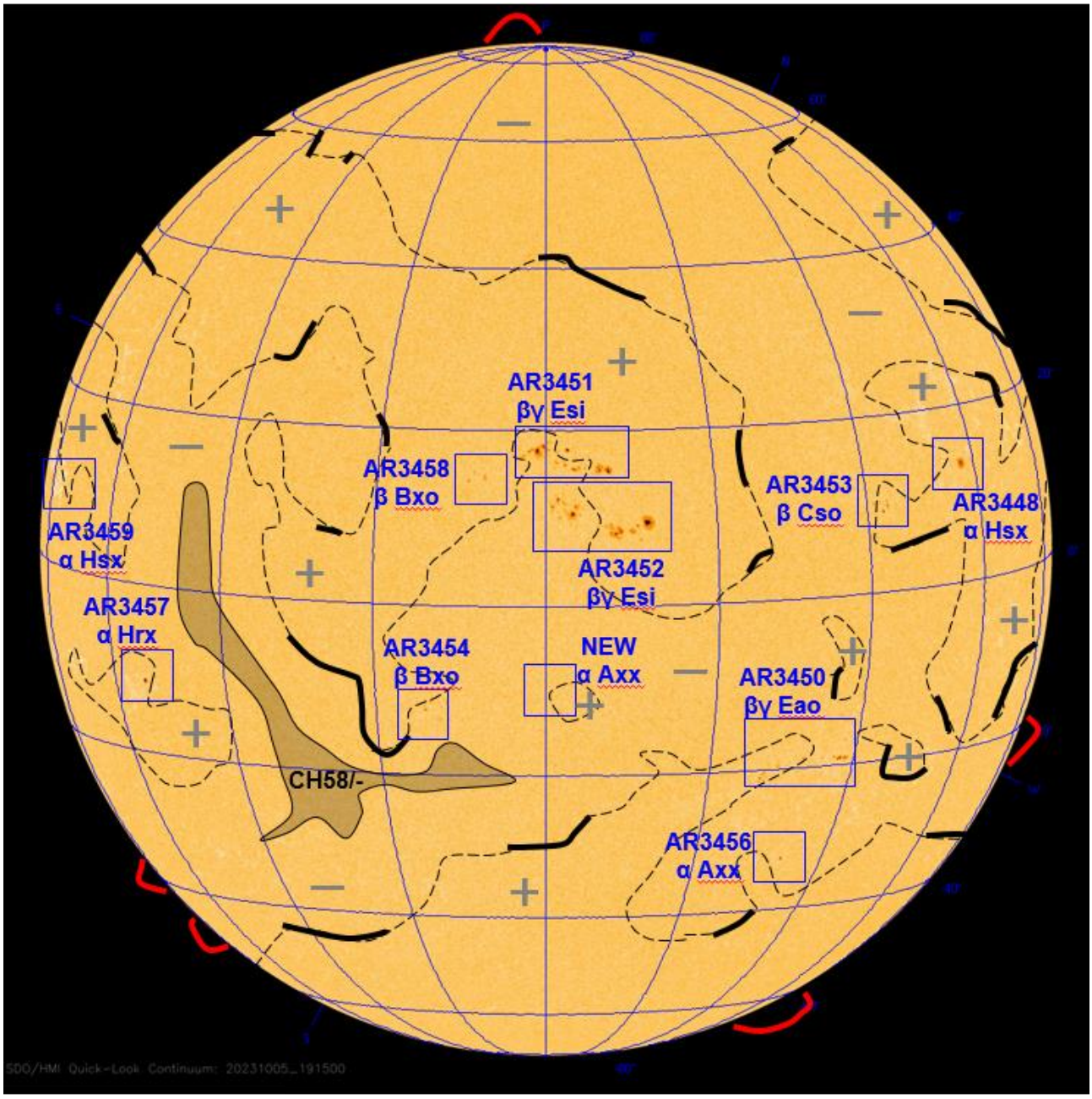
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is most likely to remain at background levels, with a very low risk of enhancements from the current sunspots on the disc. High energy electron flux (greater than 2MeV) observed by GOES16 is forecast to be mostly at background levels. Electron fluence is most likely to remain below the Active (1e8 integrated pfu) threshold with a rising trend later in the period.

Figure 1. Solar Analysis Valid 05/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the Sun on 02 Oct appears to have recently arrived at Earth. No other CMEs feature in the forecast, although, three CMEs will be analysed to determine if they have Earth-directed components.

The arrival of the CME has resulted in wind speeds of around 500km/s, with these likely to ease through 06 and 07 Oct as the effects of the CME decline. No coronal holes are due to affect the Earth in the forecast period.

Quiet to Unsettled geomagnetic activity at first, but with a chance of Active or G1/Minor Storm intervals due to the arrival of the CME at Earth. A gradual return to Quiet conditions is then expected towards the end of the period in the absence of any further CMEs.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	30	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Figure 2: Three CMEs on LASCO C3 imagery – the one on the far right is most likely to have an Earth-directed component when analysed.

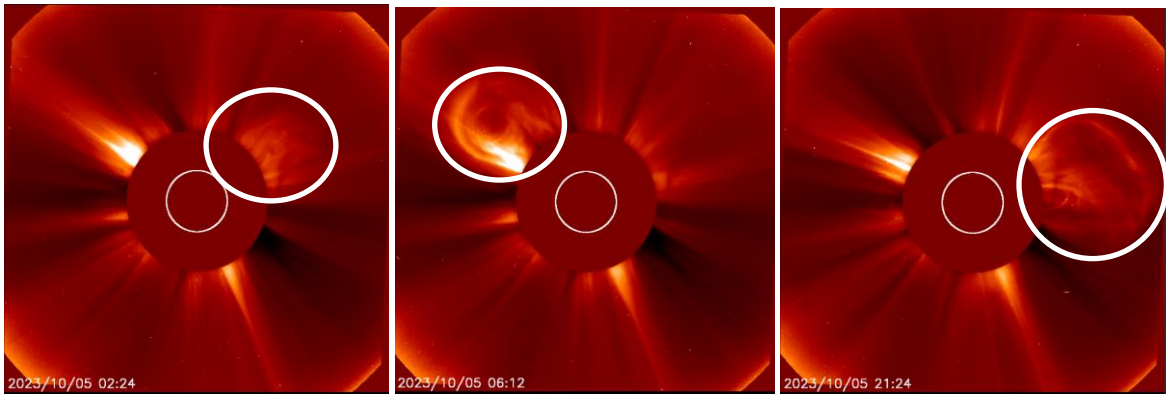

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Figure 3: Recent observations at L1, with the increases in parameters towards the end of the period indicative of a CME arrival.

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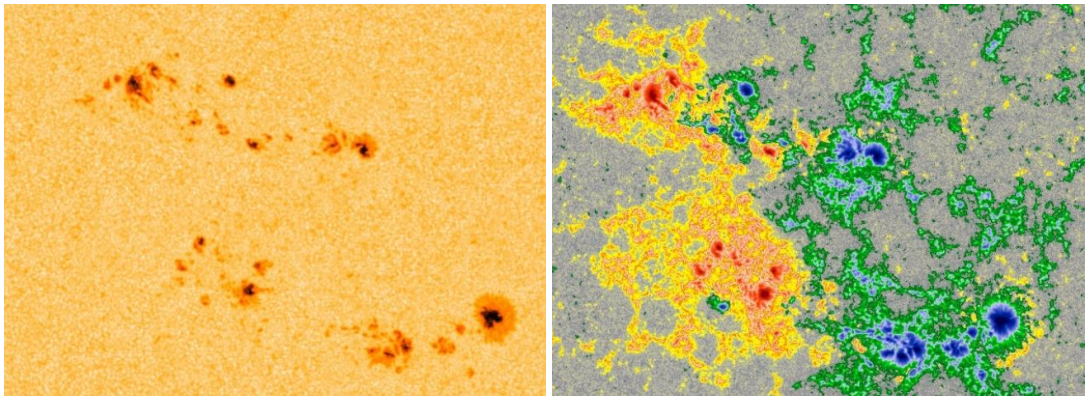
Radio Blackouts - X-Ray Flares:
There are 11 sunspot regions on the visible disc, but only three of note. AR3452 is the largest and most threatening region, with a beta gamma configuration. AR3451, to the north of AR3452 is also a beta-gamma, and has developed quickly in the last 24 hours, with a potential delta spot emerging. These two regions present the highest risk of M-class flares, with AR3450 in the southwest appearing to be weakening and easing in complexity. The remaining regions all appear to be simple or stable.

Solar activity is expected to be mainly Low, with a chance of Moderate activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: AR3451 (top) and AR3452 (bottom) on the north centre disc.



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at background levels. There is a slight increase in risk as AR3451 and AR3452 progress westwards to a more favourable position on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 has been cycling between moderate and background levels over the last 24 hours. These are then likely to drop to mainly background due to the effects of the CME, but with then a gradual increase possible due to the input of electrons into the belts, with an increasing chance of reaching high levels later in the period.

Electron fluence is forecast to be mainly at background levels but with an upward trend possible towards the end of the period as the effects of the electrons take effect.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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